

Claims

- [c1] 1. An apparatus, comprising:
a probe array mounted on an inner portion of a gimbaled bearing, said inner portion of said gimbaled bearing having a spherical surface defined by a surface of a first sphere between two parallel small circles of said first sphere, a radius of said first sphere centered on a point on a top surface of said probe array; and
an outer portion of said gimbaled bearing, said outer portion of said gimbaled bearing having a spherical surface defined by the surface of a second sphere between two parallel small circles of said second sphere, a radius of said second sphere centered on said point on said top surface of said probe array.
- [c2] 2. The apparatus of claim 1,
wherein said spherical surface of said inner portion of said gimbaled bearing and said spherical surface of said outer portion of said gimbaled bearing are concentric and separated by a layer that reduces friction between said spherical surface of said inner portion of said gimbaled bearing and said spherical surface of said outer portion of said gimbaled bearing; and

further including an adjustable tensioning mechanism connecting said inner portion of said gimbaled bearing and said outer portion of said gimbaled bearing.

[c3] 3. The apparatus of claim 1, wherein said spherical surface of said inner portion of said gimbaled bearing and said spherical surface of said outer portion of said gimbaled bearing are concentric and separated by ball gimbaled bearings; and further including an adjustable tensioning mechanism connecting said inner portion of said gimbaled bearing and said outer portion of said gimbaled bearing.

[c4] 4. The apparatus of claim 1, wherein movement of said top surface of said probe array is constrained to tilting about any line passing through said point on said top surface of said probe array.

[c5] 5. The apparatus of claim 1, further including: an inner probe card and an outer probe card, said inner probe card intervening between said probe array and a top surface of said inner portion of said gimbaled bearing, said outer probe card mounted to a top surface of said outer portion of said gimbaled bearing.

[c6] 6. The apparatus of claim 5, further including: a flexible circuit electrically connecting said inner probe

card to said outer probe card.

- [c7] 7. The apparatus of claim 1, wherein said probe array is a rigid probe array or a compliant probe array.
- [c8] 8. The apparatus of claim 1, further including means for adjusting a pressure of said probe array on I/O interconnects of a device under test.
- [c9] 9. The apparatus of claim 8, wherein said means for adjusting is selected from the group consisting of a hollow O-ring positioned between a support ring and said outer portion of said gimbaled bearing, a pressurized and pressure adjustable hollow O-ring positioned between said support ring and said outer portion of said gimbaled bearing, a pressurized and pressure adjustable piston positioned between said support ring and said outer portion of said gimbaled bearing, a pressurized and pressure adjustable bellows positioned between said support ring and said outer portion of said gimbaled bearing, and a circular array of equidistance spaced springs positioned between said support ring and said outer portion of said gimbaled bearing.
- [c10] 10. The apparatus of claim 1, further including means for adjusting an alignment of said top surface of said probe array to a reference surface of a test fixture in

which said probe array and gimbaled bearing are mounted.

[c11] 11. A method of testing, comprising:
providing a probe array;
providing a gimbaled bearing, an inner portion of said gimbaled bearing having a spherical surface defined by the surface of a first sphere between two parallel small circles of said first sphere, a radius of said first sphere centered on a point on a top surface of said probe array;
and an outer portion of said gimbaled bearing, said outer portion of said gimbaled bearing having a spherical surface defined by the surface of a second sphere between two parallel small circles of said second sphere, a radius of said second sphere centered on said point on said top surface of said probe array;
mounting said probe array on an inner portion of said gimbaled bearing; and
contacting I/O connections of a device under test with said probe array.

[c12] 12. The method of claim 11,
wherein said spherical surface of said inner portion of said gimbaled bearing and said spherical surface of said outer portion of said gimbaled bearing are concentric and separated by a layer that reduces friction between said spherical surface of said inner portion of said gim-

baled bearing and said spherical surface of said outer portion of said gimbaled bearing; and
further including providing an adjustable tensioning mechanism connecting said inner portion of said gimbaled bearing and said outer portion of said gimbaled bearing and adjusting a force pressing said spherical surface of said inner portion of said gimbaled bearing toward said spherical surface of said outer portion of said gimbaled bearing.

[c13] 13. The method of claim 11,
wherein said spherical surface of said inner portion of said gimbaled bearing and said spherical surface of said outer portion of said gimbaled bearing are concentric and separated by ball gimbaled bearings; and
further including providing an adjustable tensioning mechanism connecting said inner portion of said gimbaled bearing and said outer portion of said gimbaled bearing and adjusting a force pressing said spherical surface of said inner portion of said gimbaled bearing toward said spherical surface of said outer portion of said gimbaled bearing.

[c14] 14. The method of claim 11, wherein movement of said top surface of said probe array is constrained to tilting about any line passing through said point on said top surface of said probe array.

- [c15] 15. The method of claim 11, further including:
providing an inner probe card and providing an outer probe card, said inner probe card intervening between said probe array and a top surface of said inner portion of said gimbaled bearing, said outer probe card mounted to a top surface of said outer portion of said gimbaled bearing.
- [c16] 16. The method of claim 15, further including:
providing a flexible circuit electrically connecting said inner probe card to said outer probe card.
- [c17] 17. The method of claim 11, wherein said probe array is a rigid probe array or a compliant probe array.
- [c18] 18. The method of claim 11, further including providing means for adjusting a pressure of said probe array on said I/O interconnects of said device under test.
- [c19] 19. The method of claim 18, wherein said means for adjusting is selected from the group consisting of a hollow O-ring positioned between a support ring and said outer portion of said gimbaled bearing, a pressurized and pressure adjustable hollow O-ring positioned between said support ring and said outer portion of said gimbaled bearing, a pressurized and pressure adjustable piston positioned between said support ring and said

outer portion of said gimbaled bearing, a pressurized and pressure adjustable bellows positioned between said support ring and said outer portion of said gimbaled bearing, and a circular array of equidistance spaced springs positioned between said support ring and said outer portion of said gimbaled bearing.

[c20] 20. The method of claim 11, further including providing means for adjusting an alignment of said top surface of said probe array to a reference surface of a test fixture in which said probe array and gimbaled bearing are mounted.

[c21] 21. An apparatus, comprising:
a probe array mounted on an inner portion of a bearing, said inner portion of said bearing slidably mounted to an outer portion of said bearing, said inner bearing able to move in a direction perpendicular to a top surface of said probe array; and
means for dynamically adjusting a pressure of said probe array on I/O interconnects of a device under test.

[c22] 22. The apparatus of claim 21, wherein said means for dynamically adjusting is selected from the group consisting of a hollow O-ring positioned between said inner portion of said bearing and said outer portion of said bearing, a pressurized and pressure adjustable hollow

O-ring positioned between said inner portion of said bearing and said outer portion of said bearing, a pressurized and pressure adjustable piston positioned between said inner portion of said bearing and said outer portion of said bearing, a pressurized and pressure adjustable bellows positioned between said inner portion of said bearing and said outer portion of said bearing, and a circular array of equidistance spaced springs positioned between said inner portion of said bearing and said outer portion of said bearing.

[c23] 23. The apparatus of claim 21, further including:
an inner probe card and an outer probe card, said inner probe card intervening between said probe array and a top surface of said inner portion of said bearing, said outer probe card mounted to a top surface of said outer portion of said bearing.

[c24] 24. The apparatus of claim 23, further including:
a flexible circuit electrically connecting said inner probe card to said outer probe card.

[c25] 25. The apparatus of claim 21, wherein said probe array is a rigid probe array or a compliant probe array.

[c26] 26. A method of testing, comprising:
providing a probe array;

providing a bearing, an inner portion of said bearing slidably mounted to an outer portion of said bearing; said inner bearing able to move in a direction perpendicular to a top surface of said probe array;
providing means for dynamically adjusting a pressure of said probe array on I/O interconnects of a device under test;
mounting said probe array to said inner portion of said bearing; and
contacting I/O connections of a device under test with said probe array.

[c27] 27. The method of claim 26, wherein said means for dynamically adjusting is selected from the group consisting of a hollow O-ring positioned between said inner portion of said bearing and said outer portion of said bearing, a pressurized and pressure adjustable hollow O-ring positioned between said inner portion of said bearing and said outer portion of said bearing, a pressurized and pressure adjustable piston positioned between said inner portion of said bearing and said outer portion of said bearing, a pressurized and pressure adjustable bellows positioned between said inner portion of said bearing and said outer portion of said bearing, and a circular array of equidistance spaced springs positioned between said inner portion of said bearing and said outer portion

of said bearing.

- [c28] 28. The method of claim 26, further including:
providing an inner probe card and providing an outer probe card, said inner probe card intervening between said probe array and a top surface of said inner portion of said bearing, said outer probe card mounted to a top surface of said outer portion of said bearing.
- [c29] 29. The method of claim 28, further including:
providing a flexible circuit electrically connecting said inner probe card to said outer probe card.
- [c30] 30. The method of claim 26, wherein said probe array is a rigid probe array or a compliant probe array.